REMARKS

By this amendment, claims 3 and 4 have been cancelled. Claim 5 has been added, and claims 1 and 2 have been amended. Thus, claims 1, 2 and 5 are active in the application. Reexamination and reconsideration of the claims is requested in view of the above amendments and following remarks.

Initially, Applicant respectfully requests that the Examiner consider the Information Disclosure Statement filed April 30, 2007.

Applicant notes with appreciation the Examiner's consideration of the IDS submitted March 23, 2007.

Also, the entire specification and abstract have now been reviewed and revised in order to make various additional editorial improvements. Due to the scattered locations of the changes, a substitute specification and abstract are submitted herewith. However, no new matter has been added. For the Examiner's benefit, a marked-up version of the original specification and abstract indicating the changes made thereto is also submitted herewith.

In item 1 on Page 2 of the Office Action, claims 1-4 were rejected as being anticipated by Gali et al. (U.S. Patent No. Re. 35,643). It is respectfully submitted that this rejection is moot with respect to claims 3 and 4 and inapplicable to amended claims 1 and 2 for the following reasons.

The present invention as recited in claim 1 is directed to a method for removing membranous lead sulfate deposited on electrodes of a lead-acid battery due to sulfation. The method includes the application of a negative pulse current having a short pulse width to bring about a conductor skin effect for intensively dissolving a surface layer of the membranous lead sulfate deposited on the electrodes of the battery, the negative pulse current having a pulse width of less than 1 μs and a pulse frequency of from 8000 to 12000 Hz.

As described at page 7 lines 25-28 of the original specification and shown in present Fig. 2, a ***negative*** pulse current with a pulse width, which is so short as to give rise to the ***conductor skin effect*** is applied to the lead acid battery so as to dissolve the membranous lead sulfate deposited on the electrode into ***fine particles***. As further described at page 6, lines 9-14 of the

original specification, the pulse frequency of the negative pulse current may be increased to increase the rate at which the lead sulfate is dissolved. However, increased pulse frequency is also accompanied by heat generation. Therefore, pulse frequency is preferably of the order of from 8000 to 12000 Hz. Accordingly, amended independent claim 1 recites a ***negative*** pulse current having a ***pulse width of less than 1 μs*** and a ***frequency of from 8000 to 12000 Hz***.

In contrast, Gali discloses a lead acid battery ***combination rejuvenator and charger*** which applies a ***positive*** pulse current to a battery electrode. Specifically, Gali teaches either alternating a rejuvenation mode with a DC charging mode or ***superimposing*** positive going pulses of the rejuvenation action above the battery charging voltage (see col. 3, lines 48-50; col. 4, lines 32-35; col. 14 line 53; and col. 15, line 2). Accordingly, Gali fails to disclose a ***negative*** pulse current being applied to a battery as required by claim 1. Consequently, it is submitted that claim 1 is not anticipated by the prior art of record including the Gali patent.

With respect to the pulse current having a ***pulse width of less than 1 μs***, Gali discloses positive rejuvenating pulse signals of ***very short duration pulses in the order of 5 μs or less time width wise*** (see col. 1, line 60).

The Examiner sets forth at paragraph 5 on page 2 of the Office Action that since Gali discloses a pulse width less than 5 μs, then a pulse width value less than 1 μs is anticipated by Gali.

However, MPEP 2131.03.II provides that when the prior art discloses a range which touches or overlaps the claimed range, but no specific examples falling within the claimed range are disclosed, a case by case determination must be made as to anticipation. In order to anticipate the claims, the claimed subject matter must be disclosed in the reference with "***sufficient specificity***" to constitute an anticipation.

In this case, Gali discloses that through the application of pulse signals of ***very short duration in the order of 5μs or less time width wise***, lead sulfate deposits that have occured on battery plate surfaces will be ***released***, either going back into solution or broken up (see col. 1, lines 60-61 and col. 2, lines 2-4).

Applicant has recognized however, that there are multiple problems associated with the practice of applying pulse currents to a battery to ***release*** lead sulfate deposits from the battery plate surfaces. Specifically, there are problems with lead sulfate going back into solution and problems with broken up lead sulfate.

For example, as the lead sulfate goes back into solution, the specific gravity of the electrolytic solution may become excessively elevated, thereby resulting in damage to the polar plates and a decrease in the life of the battery (see page 2, lines 25-27 of the original specification). Also, when the lead sulfate is broken up, the flakes fall onto the peripheries of the lower parts of the polar plates or are suspended without dissolving in the electrolytic solution. Consequently, the flakes may thus again be deposited on the polar plates of the battery during discharging (see page 2, lines 13-16 of the original specification).

Thus, Gali teaches exactly the practice Applicant has identified as being associated with the aforementioned problems, specifically, the application of a pulse current having a pulse width which is ***only*** disclosed as being less than 5 μs. There are no examples given by Gali and there is no other suggestion in Gali that the extreme low end of Gali's disclosed range (e.g., less than 1 μs) would be the portion of the disclosed range that would be used.

On the other hand, Applicant has discovered a ***conductor skin effect*** which is a phenomenon in which high frequency current is localized in the ***surface layer*** of the conductor and does not penetrate deep inside of the membranous lead sulfate deposit (see page 5, lines 10-12 and page 6, lines 4-5 of the original specification). Among other benefits, the ***conductor skin effect*** allows for the membranous lead sulfate to be sequentially dissolved into fine particles, thereby preventing flaking.

In order to induce the ***conductor skin effect***, the pulse current is applied with a ***pulse width of less than 1 μs***.

Importantly, a pulse current with ***a pulse width of over 1 μs is ineligible*** because it causes thermal oscillation in a boundary face between the membranous lead sulfate deposit and the electrode, consequently permitting the lead sulfate deposit on the electrodes to exfoliate and come off (see page 6, lines 5-8 of the original specification).

Thus, even though Gali teaches the application of a pulse width "less than 5μs", Gali nonetheless fails to disclose the present invention as recited in claim 1 including bringing about of a ***conductor skin effect*** by applying a pulse current with ***a pulse width of less than 1 μs***. In other words, Gali fails to disclose the narrow range of claim 1 with ***sufficient specificity*** to constitute an anticipation thereof. Consequently, it is submitted that claim 1 is not anticipated by the Gali patent.

Claim 1 further recites that the frequency of the pulse current for bringing about the ***conductor skin effect*** is from 8,000 to 12,000 pulses per second (Hz).

In contrast, Gali discloses a rejuvenating pulse current with pulses occurring in approximately the 2,000 to 10,000 times per second range (see col. 1 lines 63-64).

Thus, the narrow range of claim 1 overlaps with the broad range disclosed by Gali. However, Applicant has discovered that the pulse number may be increased to increase the rate at which the membranous lead sulfate is dissolved. Applicant has further discovered that heat is generated when the pulse number is increased.

On the other hand, Gali provides no examples and provides no suggestion that the upper end of the disclosed range (e.g., above 8,000 Hz) would be the portion of the disclosed range that would be used. Since Gali fails to disclose the claimed range with ***sufficient specificity***, Gali fails to anticipate the invention according to claim 1 including ***the application of a pulse current having a frequency of from 8,000 to 12,000 Hz***.

Applicant has thus discovered that the invention according to claim 1, specifically, the application of a negative pulse current having a short pulse width, brings about a conductor skin effect. Specifically, high frequency current is localized in the ***surface layer*** of the conductor of the battery and does not penetrate deep inside of the membranous lead sulfate deposit (see page 5, lines 10-12 and page 6, lines 4-5 of the original specification). Among other benefits, the ***conductor skin effect*** provides the unexpected result that the membranous lead sulfate is sequentially dissolved into fine particles and thus prevented from flaking. There is no suggestion in the Gali reference that this result would have been expected by a person of ordinary skill in the

art; it is submitted that the results achieved by the particular method recited in claim 1 would not have been expected.

The claimed ranges of claim 1, specifically, the ***negative*** pulse current having a ***pulse width of less than 1 μs*** and a ***frequency of from 8000 to 12000 Hz*** are ***critical*** to the induction of the conductor skin effect. In other words, the claimed ranges of claim 1 are critical to bringing about the unexpected results.

Despite disclosing overlapping ranges, Gali fails to provide any teaching or suggestion that operating within the ranges would bring about the unexpected results discovered by Applicant. In other words, Gali fails to provide any teaching or suggestion of bringing about a ***conductor skin effect*** with a ***negative*** pulse current ***having a pulse width less than 1 μs*** and ***a pulse frequency of between 8,000 Hz to 12,000 Hz***.

For the above reasons, it is further respectfully submitted that a person of ordinary skill in the art would clearly not have found it obvious to modify the Gali patent or to make any combination of the references of record in such a manner as to result in or otherwise render obvious the present invention of claim 1.

Therefore, it is respectfully submitted that claim 1, as well as claim 2, which depends therefrom, are clearly allowable over the prior art of record.

The Examiner's attention is also directed to the new dependent claim 5 which sets forth that the pulse width of the negative pulse current is in the range of 0.1 μs to 1 μs.

In view of the foregoing amendments and remarks it is respectfully submitted that the present application is clearly in condition for allowance. An early notice thereof is earnestly solicited.

Respectfully submitted,

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